Complete Summary

GUIDELINE TITLE

ACR Appropriateness Criteria™ for progressive neurologic deficit.

BIBLIOGRAPHIC SOURCE(S)

Johnson BA, Drayer BP, Anderson RE, Braffman B, Davis PC, Deck MD, Hasso AN, Masaryk T, Pomeranz SJ, Seidenwurm D, Tanenbaum L, Masdeu JC. Progressive neurological deficit. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):437-57. [60 references]

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Progressive neurological deficit

GUIDELINE CATEGORY

Diagnosis

CLINICAL SPECIALTY

Neurological Surgery
Neurology
Oncology
Radiology

INTENDED USERS

Health Plans
Hospitals

Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for progressive neurological deficit

TARGET POPULATION

Patients with progressive neurological deficit

INTERVENTIONS AND PRACTICES CONSIDERED

1. Magnetic resonance:
    - Unenhanced
    - Enhanced (pre- and postcontrast)
    - Double- triple-dose enhanced
2. Functional magnetic resonance imaging
3. Magnetic resonance spectroscopy
4. Magnetic resonance angiography
5. Computed tomography:
    - Unenhanced
    - Enhanced (pre- and postcontrast)
    - Double-dose delayed enhanced
6. Computed tomography angiography
7. Catheter angiography
8. Ultrasound
9. Single-photon emission computed tomography
10. Positron emission tomography

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of recent peer-reviewed medical journals, primarily using the National Library of Medicine's MEDLINE database. The developer identified and collected the major applicable articles.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Expert Consensus (Delphi Method)
Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed to reach agreement in the formulation of the Appropriateness Criteria. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by the participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty (80) percent agreement is considered a consensus. If consensus cannot be reached by this method, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria and the Chair of the ACR Board of Chancellors.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria™

Clinical Condition: Patient Without Known Disease Presenting with a Progressive Neurological Deficit

Variant 1: Progressive neurological deficit in a child.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	6	
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		

Unenhanced computed tomography	6	
Enhanced computed tomography (pre- and postcontrast)	6	
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	4	
Computed tomography angiography	2	
Catheter angiogram	No Consensus	
Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	2	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient Without Known Disease Presenting with a Progressive Neurological Deficit

Variant 2: Progressive neurological deficit in an adult younger than 40 years old.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic	6	

resonance (pre- and postcontrast)		
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced computed tomography	7	
Enhanced computed tomography (pre- and postcontrast)	6	
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	4	
Catheter angiogram	3	
Computed tomography angiography	2	
Nuclear Medicine		
Single-photon emission computed tomography	3	
Positron emission tomography	2	
Ultrasound	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient Without Known Disease Presenting with a Progressive Neurological Deficit

Variant 3: Progressive neurological deficit in an adult older than 40 years old.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	8	
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced computed tomography	6	If magnetic resonance is not available.
Enhanced computed tomography (pre- and postcontrast)	6	
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	4	
Computed tomography angiography	3	Relatively new modality with promising clinical utility.
Catheter angiogram	2	

Ultrasound	3	
Nuclear Medicine		
Positron emission tomography	2	
Single-photon emission computed tomography	No Consensus	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient Without Known Disease Presenting with a Progressive Neurological Deficit

Variant 4: Progressive neurological deficit and cranial neuropathy in a child.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	8	
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced computed tomography	4	
Enhanced computed	4	

tomography (pre- and postcontrast)		
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	4	
Computed tomography angiography	2	
Catheter angiogram	2	
Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	2	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient Without Known Disease Presenting with a Progressive Neurological Deficit

Variant 5: Progressive neurological deficit and cranial neuropathy in an adult.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	9	
Enhanced magnetic resonance (pre- and postcontrast)	8	

Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Enhanced computed tomography (pre- and postcontrast)	4	
Unenhanced computed tomography	3	If magnetic resonance imaging is adverse or not available.
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	4	
Catheter angiogram	4	May be indicated if suspect aneurysm.
Computed tomography angiography	3	If magnetic resonance imaging is adverse or not available.
Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	2	
Positron emission tomography	2	

Appropriateness Criteria Scale

1 2 3 4 5 6 7 8 9

1=Least appropriate 9=Most appropriate

Clinical Condition: Patient Without Known Disease Presenting with a Progressive Neurological Deficit

Variant 6: Progressive neurological deficit: negative screening computed tomography or magnetic resonance.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	6	
Double- triple-dose enhanced magnetic resonance	4	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Vascular imaging		
Magnetic resonance angiography	4	
Computed tomography angiography	3	
Catheter angiogram	2	
Computed tomography		
Enhanced computed tomography (pre- and postcontrast)	4	
Unenhanced computed tomography	2	
Double-dose-delayed enhanced computed tomography	2	

Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	No Consensus	
Positron emission tomography	No Consensus	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient Without Known Disease Presenting with a Progressive Neurological Deficit

Variant 7: Progressive neurological deficit in patient from/traveling to an endemic region for infection (e.g., tuberculosis).

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	8	
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced computed tomography	6	
Enhanced computed	6	

tomography (pre- and postcontrast)		
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	2	
Computed tomography angiography	2	
Catheter angiogram	2	
Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	2	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient With Known Disease Presenting With a Progressive Neurological Deficit

Variant 8: Progressive neurological deficit in patient with known extra-central nervous system neoplasm.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	8	Contrast necessary for optimal sensitivity.
Double- triple-dose	3	May be useful for problem solving

enhanced magnetic resonance		if equivocal enhancement.
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Enhanced computed tomography (pre and post contrast)	5	Magnetic resonance more sensitive; however, computed tomography will demonstrate most symptomatic lesions.
Unenhanced computed tomography	4	
Double-dose-delayed enhanced computed tomography	4	
Vascular imaging		
Magnetic resonance angiography	2	
Computed tomography angiography	2	
Catheter angiogram	2	
Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	2	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient Without Known Disease Presenting with a Progressive Neurological Deficit

Variant 9: Progressive neurological deficit in patient with known extra-central nervous system neoplasm; solitary metastasis on initial study.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Enhanced magnetic resonance (pre- and postcontrast)	8	
Double- triple-dose enhanced magnetic resonance	6	Presurgical or other intervention (radiation therapy [XRT]).
Unenhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Enhanced computed tomography (pre- and postcontrast)	4	
Double-dose-delayed enhanced computed tomography	3	If magnetic resonance is not available.
Unenhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	2	
Computed tomography angiography	2	
Catheter angiogram	2	
Ultrasound	2	
Nuclear medicine		

Single-photon emission computed tomography	2	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient With Known Disease Presenting With a Progressive Neurological Deficit

Variant 10: Progressive neurological deficit in patient with known primary central nervous system neoplasm- recurrent symptoms.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Enhanced magnetic resonance (pre- and postcontrast)	9	
Unenhanced magnetic resonance	8	
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced computed tomography	5	Magnetic resonance preferred.
Enhanced computed tomography (pre- and postcontrast)	5	Enhanced magnetic resonance preferred.
Double-dose-delayed	2	

enhanced computed tomography		
Vascular imaging		
Magnetic resonance angiography	2	
Computed tomography angiography	2	
Catheter angiogram	2	
Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	No Consensus	May be useful in specific clinical circumstances.
Positron emission tomography	No Consensus	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient with Known Disease Presenting with a Progressive Neurological Deficit

Variant 11: Progressive neurological deficit in patient with known central nervous system neoplasm status post radiation therapy (XRT) and an enhancing mass.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	8	
Double- triple-dose enhanced magnetic resonance	4	

Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Nuclear medicine		
Single-photon emission computed tomography	5	Often useful for problem solving and surgical planning.
Positron emission tomography	5	Often useful for problem solving and surgical planning.
Computed tomography		
Unenhanced computed tomography	4	
Enhanced computed tomography (pre- and postcontrast)	4	
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	2	
Computed tomography angiography	2	
Catheter angiogram	2	
Ultrasound	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient With Known Disease Presenting With a Progressive Neurological Deficit

Variant 12: Progressive neurological deficit in patient with systemic infection (e.g., tuberculosis).

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre and post contrast)	8	
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced computed tomography	6	
Enhanced computed tomography (pre- and postcontrast)	6	
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	4	
Computed tomography angiography	2	
Catheter angiogram	2	
Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	2	

Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient With Known Disease Presenting With a Progressive Neurological Deficit

Variant 13: Progressive neurological deficit in an immunocompromised patient (e.g., AIDS).

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	8	
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced computed tomography	6	
Enhanced computed tomography (pre- and post contrast)	6	
Double-dose-delayed enhanced computed tomography	3	Magnetic resonance preferred.

Nuclear medicine		
Single-photon emission computed tomography	4	In some instances, useful for problem solving and lesion analysis.
Positron emission tomography	2	An advantage over single-photon emission computed tomography has not been demonstrated.
Vascular imaging		
Magnetic resonance angiography	2	
Computed tomography angiography	2	
Catheter angiogram	2	
Ultrasound	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient With Known Disease Presenting With a Progressive Neurological Deficit

Variant 14: Progressive neurological deficit in a patient with autoimmune disorder (e.g., systemic lupus erythematosus).

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	8	
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical

		problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced computed tomography	6	
Enhanced computed tomography (pre- and postcontrast)	4	Magnetic resonance preferred.
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Catheter angiogram	5	For suspected vasculitis.
Magnetic resonance angiography	3	More useful for assessing large vessel disease.
Computed tomography angiography	2	
Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	2	
Positron emission tomography	2	
Appropriateness Criteria Scale 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Patient With Known Disease Presenting With a Progressive Neurological Deficit

Variant 15: Progressive neurological deficit in a patient with neurocutaneous syndrome (e.g., neurofibromatosis).

Radiologic Exam	Appropriateness	Comments

Procedure	Rating	
Magnetic resonance		
Unenhanced magnetic resonance	8	
Enhanced magnetic resonance (pre- and postcontrast)	8	
Double- triple-dose enhanced magnetic resonance	2	
Functional magnetic resonance imaging	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Magnetic resonance spectroscopy	No Consensus	Rapidly developing technologies that may prove useful for clinical problem solving.
Computed tomography		
Unenhanced computed tomography	6	
Enhanced computed tomography (pre- and postcontrast)	6	
Double-dose-delayed enhanced computed tomography	2	
Vascular imaging		
Magnetic resonance angiography	4	
Catheter angiogram	3	If vasculopathy is suspected.
Computed tomography angiography	2	
Ultrasound	2	
Nuclear medicine		
Single-photon emission computed tomography	2	
Positron emission	2	

tomography		

Appropriateness Criteria Scale

1 2 3 4 5 6 7 8 9

1=Least appropriate 9=Most appropriate

Summary

A patient presenting with a progressive neurological deficit warrants consideration of the entire neuraxis. The offending pathology is localized on the basis of the clinical history and physical examination. Additional information is obtained on the basis of the temporal course of the deficit. For example, an acute temporal course prompts evaluation for stroke, but a more chronic course is typically demonstrated with a mass lesion.

An expanding intracranial lesion is suspected when a patient presents with progressive weakness, impaired speech, personality change, or a sensory deficit. Hemiplegia is the most common form of paralysis. Monoplegia and, less commonly, bilateral weakness may also be caused by an intracranial lesion. The latter is usually caused by cord compromise, but occasionally brain stem or cerebral pathology produce bilateral symptomatology. The cardinal signs of an intracranial tumor include headache, vomiting, and papilledema. This triad is present in a few cases, however, and is usually caused by obstructive hydrocephalus or marked peritumoral vasogenic edema. Cranial nerve deficits accompanying contralateral weakness localize pathology to the brainstem. Clinical localization of pathology requires consideration of motor tracts, extraparameter signs, stance, and gait as well as somatic sensation. When formulating a differential diagnosis, the temporal course of symptoms and patient demographics are considered in addition to physical findings.

Disease categories associated with an intracranial mass that cause progressive neurologic deficits include neoplastic, inflammatory, or vascular lesions. Imaging studies are performed to exclude an intracranial lesion and to characterize the offending pathology. Such lesions generally cause progressive deficit that does not spontaneously resolve. These patients should undergo imaging evaluation after physical examination is performed. On the other hand, it has been found that atraumatic patients with resolved neurological deficits are unlikely to benefit from cranial computed tomography.

The introduction of computed tomography provided a noninvasive imaging modality superior to radionuclide scanning. Even the current generation of nuclear medicine cameras and scanners lack the spatial resolution and sensitivity required for the detection of intracranial neoplasms, especially metastases.

It is well established that contrast agents yield additional information on computed tomography studies. Increasing the iodine dose further increases conspicuity of some lesions, often yielding supplementary diagnostic information. This affect is augmented by delayed image acquisition after contrast. Current-generation scanners have significantly improved sensitivity. Nonetheless, certain

pathology is difficult to visualize with computed tomography. This is especially true for white matter disease and other lesions that may not produce significant mass effect. Also, compared with its ability to detect intraparenchymal lesions, computed tomography is not as reliable for delineating leptomeningeal or dural disease.

Although the sensitivity of enhanced computed tomography may be augmented using double-dose-delayed technique, enhanced magnetic resonance is even more sensitive for detecting primary and secondary brain neoplasms, and for defining the extent of disease. Even before the availability of magnetic resonance contrast agents, this modality surpassed computed tomography in sensitivity for the detection of intraparenchymal pathology. In addition to superior contrast resolution, magnetic resonance allows multiplanar acquisition and spares patients ionizing radiation. Magnetic resonance imaging provides information that is not available by other noninvasive means, and sometimes it approaches the accuracy of a neuropathologic diagnosis.

Magnetic resonance is especially useful for evaluating the posterior fossa, which is often less well visualized with computed tomography because of artifact. Magnetic resonance is not superior not only for the detection of brain stem lesions, but also for characterization of hemorrhagic residua. Brain stem ischemia is not uncommon in older adults, and it may rarely occur in children. Suspected brain stem and other posterior fossa pathologies argue strongly for magnetic resonance imaging over computed tomography because of computed tomography artifact caused by adjacent bony structures.

Enhanced magnetic resonance is also the modality of choice for patients with cranial neuropathy. In fact, while computed tomography may be preferable for the evaluation of bony trauma, acute subarachnoid blood and in some head and neck disorders, magnetic resonance has become the modality of choice for most central nervous system disorders. Of course, nonavailability, incompatible life support apparatus, ferromagnetic aneurysm clips, and other contraindications to magnetic resonance imaging will prompt consideration for computed tomography even for diseases best evaluated with magnetic resonance. Hemorrhagic lesions are characterized more accurately with magnetic resonance. Although it is often impossible to distinguish tumoral hemorrhage from other causes on computed tomography, magnetic resonance features are often detected, which suggest an underlying malignancy. Furthermore, although computed tomography is more sensitive for the detection of small calcifications, magnetic resonance is more sensitive for the detection of small hemorrhagic foci associated with vascular malformations, and it provides a more specific imaging appearance.

The computed tomography appearance of infectious masses has been well described. Earlier detection in combination with improved therapeutic measures for intracranial infections has produced a significant decrease in the number of complications such as extension to extra-axial spaces, hemorrhage, infarction, compartmental herniation, and death. Although it is less sensitive for the detection of small calcifications, magnetic resonance imaging provides greater sensitivity for the assessment of intracranial abscess and granulomas, and may be more specific. However, even in endemic areas, the imaging appearance of such lesions is not specific enough to preclude histological confirmation before treatment.

As with computed tomography, enhanced images augment the sensitivity of cranial magnetic resonance for the evaluation of several disease categories. This is especially true for the detection of intracranial metastatic disease. The efficacy of enhanced magnetic resonance has been demonstrated in children and adults. Even the absence of enhancement provides additional information. For example, in patients with a known primary neoplasm, frequently-encountered white matter lesions that do not enhance have a low likelihood of representing metastatic disease. Enhanced magnetic resonance is more sensitive than enhanced computed tomography for the detection of intracranial lesions, even if double-dose-delayed computed tomography technique is employed.

Although contrast agents allow the detection of metastases that are occult on unenhanced studies, virtually all primary brain neoplasms seen on enhanced images will be identified on unenhanced sequences. Thus, while contrast agents aid the characterization of primary brain tumors, they may not be essential for screening examinations for such lesions. Stratification of patients who should receive contrast based on age then becomes an issue. Metastatic disease affects all age groups, but the incidence increases significantly after the fourth decade. More than 75% of patients harboring central nervous system metastases are between ages 40 and 70 years.

As was demonstrated with computed tomography, high-dose enhanced magnetic resonance has demonstrated an increase in lesion contrast, apparent size, and border definition compared with single-dose examinations. The administration of triple-dose magnetic resonance contrast agents often reveal more lesions than does a single dose. High-dose magnetic resonance imaging is more sensitive for the detection of intracerebral metastases than delayed standard dose magnetic resonance. Because there is evidence that resection of a solitary metastatic lesion (or a small number of lesions) improves patient survival, detection of a solitary lesion versus multiple lesions is likely to impact patient management. There is little argument that patients considered for surgical resection of a solitary metastatic nodule detected on noncontrast magnetic resonance studies or enhanced computed tomography should undergo an enhanced magnetic resonance examination to exclude the presence of additional lesions. There is still debate on which patients should receive triple- dose contrast, however.

Anatomic images may provide insufficient information for neurosurgeons who are contemplating resection of a lesion that borders eloquent cortex. Distortion of the motor strip and other vital parenchyma may occur secondary to an expanding adjacent mass. The functional plasticity of the brain may not be reflected on conventional anatomic imaging studies. Preoperative (or preradiation) functional imaging for mapping of eloquent cortex more precisely delineates motor and speech areas and may contribute to surgical and treatment planning. Such studies may supplant or accompany intraoperative neurophysiological testing for mapping the motor strip prior to resection of brain tumors.

In previously treated patients with brain neoplasms presenting with new neurological complaints, distinguishing radiation necrosis from tumor recurrence is a diagnostic challenge. These lesions, which may have a similar appearance on enhanced magnetic resonance, call for significantly different clinical management. Nuclear medicine single-photon emission computed tomography or positron emission tomography studies may provide improved specificity. These modalities

are not universally reliable for making this distinction, however. Early work with magnetic resonance spectroscopy suggests that this may also prove useful for distinguishing radiation necrosis from tumor recurrence. Catheter angiography has traditionally been employed to assess tumor vascularity. More recently, evaluation of tumor vascularity using dynamic magnetic resonance imaging has been advocated. The trend toward less invasive assessment of intracranial pathology continues to accelerate.

Patients with parenchymal infectious lesions often have no fever or other systemic signs of infection, and may have a normal cerebrospinal fluid profile. Furthermore, the presence of fever is nonspecific. For example, noninfectious lesions may be associated with postictal fever, resulting in a false positive sign for infection. Cross-sectional imaging is vital for the management of such patients. Magnetic resonance is superior to computed tomography for the evaluation of parenchymal abscesses and their complication. It is also more sensitive for the evaluation of extra-axial infection. Diffusion-weighted imaging may allow differentiation of brain abscess from necrotic or cystic brain tumors.

AIDS patients initially present with neurological symptoms in up to half of cases, and should undergo cranial imaging in order to guide clinical management. The treatment for the most common intracranial lesions in these patients must be instituted promptly. Magnetic resonance is superior to computed tomography for the detection of white matter lesions and vasogenic edema. Despite the excellent capacity to delineate lesions on magnetic resonance, however, distinguishing mass lesions caused by toxoplasmosis versus primary central nervous system lymphoma is often difficult on the basis of anatomic imaging. Some magnetic resonance features may favor one diagnosis over the other, but the distinction is often difficult. Although enhanced images have been shown to provide additional information in AIDS patients who present for cranial magnetic resonance, the value of routine use of intravenous gadolinium contrast agents in AIDS patients has been challenged. Thallium-201 uptake is a feature of lymphoma; a feature that may be exploited by performing single-photon emission computed tomography on AIDS patients presenting with intracranial lesions. Characterizing the lesions' biochemical profiles using H-1 spectroscopy may provide another noninvasive, more specific, method for differentiating these lesions. In addition to contributing to clinical management, imaging findings also have prognostic implications in AIDS patients. The presence of focal lesions or atrophy show a significantly greater risk of death than that for patients who present with normal neuroimaging examinations. The risk is even greater if both findings are present. Additional information may be obtained from perfusion magnetic resonance magnetic resonance imaging. Reduced relative cerebral blood volume (rCBV) in toxoplasmosis lesions has been described, vs. increased relative cerebral blood volume in lymphomas, which may allow differentiation of mass lesions in AIDS patients caused by these diseases.

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Appropriate selection of radiologic exam procedures to diagnose progressive neurological deficit.

Subgroups Most Likely to Benefit:

Patients with intracranial infections. Earlier detection in combination with improved therapeutic measures for intracranial infections has produced a significant decrease in the number of complications such as extension to extra-axial spaces, hemorrhage, infarction, compartmental herniation, and death.

POTENTIAL HARMS

Not stated

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Living with Illness

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Johnson BA, Drayer BP, Anderson RE, Braffman B, Davis PC, Deck MD, Hasso AN, Masaryk T, Pomeranz SJ, Seidenwurm D, Tanenbaum L, Masdeu JC. Progressive neurological deficit. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun;215(Suppl):437-57. [60 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1996 (revised 1999)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria™.

GUIDELINE COMMITTEE

ACR Appropriateness Criteria™ Committee, Expert Panel on Neurologic Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Names of Panel Members: Thomas Masaryk, MD; Burton P. Drayer, MD; Robert E. Anderson, MD; Bruce Braffman, MD; Patricia C. Davis, MD; Michael D. F. Deck, MD; Anton N. Hasso, MD; Blake A. Johnson, MD; Stephen J. Pomeranz, MD; David Seidenwurm, MD; Lawrence Tanenbaum, MD; Joseph C. Masdeu, MD, PhD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline. It is a revision of a previously issued version (Appropriateness criteria for progressive neurological deficit. Reston [VA]: American College of Radiology [ACR]; 1996. 21 p. [ACR Appropriateness Criteria™]).

The ACR Appropriateness Criteria™ are reviewed after five years, if not sooner, depending upon introduction of new and highly significant scientific evidence. The next review date for this topic is 2004.

GUIDELINE AVAILABILITY

Electronic copies: Available from the American College of Radiology (ACR) Web site.

Print copies: Available from ACR, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on July 31, 2001. The information was verified by the guideline developer as of August 24, 2001.

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